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AND
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To: D. Leyden
From: R. Carchman *RC*
Subject: 1992 Operational Plans for the Sensory Technology Program
Date: February 5, 1992

The purpose of the Sensory Technology Program is to develop a fundamental understanding of the sensory characteristics of current and future products in order to improve their commercial success. The program's *initial* efforts will be directed toward developing: 1) a sensory enhancement/replacement for nicotine; 2) methods to optimize the flavor and impact of low tar/low nicotine products; and 3) a flavor delivery system for nonconventional smoking articles. Subsequent to accomplishing initial goals, we will embark upon additional aspects of the program.

Objective

To develop the technology to produce low alkaloid and low tar/low alkaloid cigarettes that have sensory characteristics superior to currently available products.

A. *De-Nic (1994)*

Strategy

Develop a fundamental understanding of how nicotine affects sensory systems.

Rationale: A fundamental understanding of the effects of nicotine on sensory systems is a necessary first step in finding a sensory replacement/enhancer for nicotine.

Status: A literature review of the chemosensory properties of nicotine has been completed. A literature review of local events in the receptor environment is in progress. A sensory screen for nicotine and nicotine-like compounds has been implemented at INBIFO.

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Tactics

Compile published information on the mechanisms by which nicotine affects chemosensory systems. (PED (*Ennis*), SIA (*DeBardeleben*) - Complete February, 1992).

Compile published information on how local events in the receptor environment (e.g., salivary pH) affect sensory responses to cigarettes. (PED (*Ennis*), SIA (*DeBardeleben*) - Complete April, 1992).

Evaluate test compounds which have been determined to be potential sensory substitutes or modifiers for nicotine. (INBIFO (*VonHolt*) - In progress).

Conduct sensory evoked potential and subjective evaluations of promising and acceptable sensory substitutes for nicotine at P.M. Richmond. (BCR (*Gullotta*), FTD (*Yatrakis*) - As available).

Identify, negotiate with, and fund laboratories with pertinent expertise to develop receptor assays for olfactory and trigeminal systems. (BCR (*Gullotta*) - Complete December, 1992).

B. *Half-Nic* (1992)

Strategy #1

Develop an analytical approach to the measurement of the acid/base character of filler and smoke.

Rationale: Enhanced subjective and electrophysiological responses may be due to the ratios of protonated to free base nicotine.

Status: Literature and historical methodologies for smoke "pH" measurement have been evaluated. One method for measuring puff-by-puff "pH" of smoke is being reestablished in CTSD. An annular denuder approach to the determination of gas phase nicotine has been evaluated.

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Tactics

Reestablish puff-by-puff "pH" method. (ARD (*Lephardt*) - Complete March, 1992).

Initiate puff-by-puff tests on cigarette models provided by Flavor Technology. (ARD (*Lephardt*) - Begin March, 1992 and continuing as models become available.)

Utilize the annular denuder method to evaluate the gas phase nicotine deliveries of cigarette models provided by Flavor Technology. (ARD (*Lephardt*) - Begin February, 1992 and continuing as models become available).

Strategy #2

Evaluate the effects of increasing filler and smoke "pH" on the sensory and subjective characteristics of cigarettes.

Rationale: Previous studies employing cigarettes made from filler treated with bases indicate that such cigarettes may be subjectively superior to the same cigarettes made from untreated filler.

Status: Preliminary subjective and sensory evoked potential studies have been completed using cigarettes made from $\text{Ca}(\text{OH})_2$ and KOH treated filler. POLs are being conducted on cigarettes treated with 2% $\text{Ca}(\text{OH})_2$.

Tactics

Conduct subjective and sensory evoked potential testing of:

1. Cigarettes made from $\text{Ca}(\text{OH})_2$ treated filler. (FTD (*Yatrakis*), BCR (*Gullotta*) - Complete March, 1992).
2. Cigarettes made from filler treated with $\text{Ca}(\text{OH})_2$ precursors. (CRD (*Grubbs*), FTD (*Yatrakis*), BCR (*Gullotta*) - Complete April, 1992).
3. Cigarettes made from filler treated with alternate bases. (CRD (*Grubbs*), FTD (*Yatrakis*), BCR (*Gullotta*) - Complete September, 1992).

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Strategy #3

Investigate the kinetic effects of nicotine at various pH levels.

Rationale: The literature indicates that nicotine may be more efficiently utilized at higher pH levels.

Status: Methodologies and instrumentation for conducting kinetic studies have been established and tested at INBIFO.

Tactic

Conduct mechanistic studies to determine how pH alters the time course of observed responses. (INBIFO (*VonHolt*) - Complete June, 1992).

Strategy #4

Investigate the distribution of smoke particle size at different "pH" levels.

Rationale: Particle size may be an important factor involved in the subjective responses to cigarettes. Therefore, the ability to manipulate particle size may permit us to exert greater control over cigarette subjectives.

Status: Particle size studies using light scattering methods have been conducted using conventional cigarettes. These experiments need to be extended to cigarettes made with "pH" modified filler.

Tactic

Conduct experiments employing light extinction spectrometry to investigate the distribution of smoke particle size in "pH" modified filler. (PRD (*Nguyen, Lipowicz*) - Complete March, 1992).

Strategy #5

Determine the distribution and hydration state of nicotine in smoke at different "pH" levels.

Rationale: The distribution and hydration state of nicotine at higher "pH" levels may be responsible for the improved subjectives of cigarettes made from filler treated with bases.

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Status: Studies to be initiated during the first quarter of 1992.

Tactics

Develop and conduct vapor-liquid equilibrium (VLE) experiments to measure the concentration of free base nicotine in vapor at various pH levels. (PRD (*Lipowicz*), Technology Assessment (*Banyasz*) - Complete July, 1992).

Following the above, determine the species distribution of nicotine at various pH levels. (PRD (*Lipowicz*), Technology Assessment (*Banyasz*) - Complete September, 1992).

Strategy #6

To evaluate the applicability of filter technology to improve the sensory characteristics of low tar/low alkaloid cigarettes.

Rationale: Filter components and construction can affect the sensorial attributes of cigarette smoke from this category of cigarettes. To that end, cigarette models will be prepared using a variety of filter materials and configurations for Half-Nic and De-Nic type products. As these models are evaluated and improved subjective responses are perceived, they will be made available to Sensory Technology for appropriate testing.

Status: Filter technology is currently responding to the schedule(s) developed by/for Flavor Technology for the Half-Nic/De-Nic program. The following types of filters will be designed and tested on the most current cigarette models:

Dual CA/PCC filter with lower ventilation than conventional CA
Dual CA/paper filters
Novel designs such as triple filter
Filter additives

Tactics

Investigate the distribution of smoke particle size in cigarettes employing varying filter prototypes (e.g., CA paper filter, concentric filter, etc.) provided by the ART program. (Filter Technology (*J. Hearn*) - Begin April, 1992 and continuing as prototypes become available).

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Investigate the distribution of nicotine between gas and particulate phase smoke in cigarettes employing varying filter prototypes provided by the ART program. (Filter Technology (*Hearn*) - Begin April, 1992 and continuing as prototypes become available.)

C. ***Low Tar/High Flavor (Continuing)***

Strategy

Utilize the information gained from A and B to produce an acceptable low tar/high flavor product.

Rationale: The information gained from studies on Half-Nic and De-Nic are being applied to fillers used for new low tar/high flavor cigarettes.

Status: Bases used on Half-Nic and De-Nic are being applied to fillers used for new low tar/high flavor cigarettes.

Tactics

See De-Nic and Half-Nic

Objective

To develop a flavor delivery system for use in nonconventional smoking articles by 1995.

Strategy

Investigate the subjective and electrophysiological properties of a nicotine aerosol system(s).

Rationale: To better understand how nicotine produces its sensory and subjective effects in a simpler, more highly controlled system.

Status: Preliminary electrophysiological and subjective investigations of aerosols containing nicotine at several pH levels have been conducted using a DeVilbis nebulizer.

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Tactics

Evaluate the physical characteristics of various nicotine aerosol systems. (PRD (*Lipowicz*) - In progress).

Conduct subjective and sensory evoked potential evaluations of nicotine aerosols at various pH levels. (BCR (*Gullotta*), PRD (*Lipowicz*) - Complete June, 1992).

Perform subjective and sensory evoked potential studies on nicotine aerosols at various pH and menthol levels. (BCR (*Gullotta*), PRD (*Lipowicz*) - Complete November, 1992).

Conduct subjective and sensory evoked potential investigations of nicotine aerosols containing to-be-identified flavorants and sensory enhancers. (BCR (*Gullotta*), PRD (*Lipowicz*) - Begin December, 1992).

1992 Resource Allocations

<u>DIVISION</u>	<u>PERSONNEL (man-years)</u>
Biochemical Research	3.50
Chemical Research	1.00
Product Evaluation	1.00
Analytical Research	1.50
Physical Research	0.50
Flavor Technology	2.00
Technology Assessment	0.25
Strategic Information Assessment	0.25
Filter Technology	0.25
INBIFO	1.25

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